CLAIMS

What is claimed is:

1. A method for receiving radio signals in a multiple peer-to-peer link hopping radio system, the method comprising:

hopping among a plurality of radio links and receiving bursts of radio signals on the plurality of radio links;

determining channel information for each radio link from a received burst on the radio link;

storing the determined channel information; and

using the determined channel information for the radio link to reliably receive a next received burst on the radio link.

2. The method of claim 1 further comprising:

equalizing received radio signals according to updated equalizer weights;

updating the equalizer weights for the next received burst using the determined channel information from a received burst.

3. The method of claim 1 wherein receiving bursts of radio signals comprises receiving one of a data burst and an invitation burst.

4. The method of claim 3 wherein each respective data burst and invitation burst comprises data symbols and known pilot symbols at a known timing position inside the respective data burst or invitation burst.

5. The method of claim 3 wherein receiving bursts comprises detecting two or more pilot symbols in a received data burst.

6. The method of claim 4 further comprising:

demodulating the received burst.

7. The method of claim 6 wherein demodulating comprises:

estimating channel phase and amplitude variations from symbols having known amplitude and phase in the received burst.

8. The method of claim 4 wherein receiving bursts of radio signals comprises detecting the known pilot symbols near the center of a received data burst.

9. The method of claim 8 wherein detecting the known pilot symbols comprises detecting consecutive symbols at 180 degrees phase relative to each other.

10. The method of claim 9 wherein the known consecutive symbols have maximum amplitude with opposite signs.

11. The method of claim 3 wherein receiving bursts comprises detecting a plurality of known pilot symbols per each received invitation burst at a known timing within the received invitation burst to allow an accurate estimate of carrier phase offset.

12. The method of claim 1 wherein determining channel information comprises:

establishing link parameters for a radio link in a new joining node joining the radio system; and

storing the link parameters as initial stored channel information.

13. The method of claim 12 wherein using the determined channel information comprises using the initial stored channel information for demodulating of a next data burst on the radio link with the new joining node.

14. The method of claim 13 further comprising:

receiving an invitation burst for a radio link with a new joining node joining the radio system;

storing equalizer weights determined using the invitation burst;

in an adaptive T/N-spaced equalizer, equalizing a data burst using stored equalizer weights to form channel parameters;

recovering carrier phase for the data burst by

forming a coarse estimate of carrier phase based on the channel parameters and pilot symbols in the data burst, and

forming a carrier phase estimate based on the channel parameters and the coarse estimate; and

updating the equalizer weights for equalization of a subsequent data burst.

15. A method for receiving radio signals in a link-hopping, burst mode radio receiver, the method comprising:

receiving a first burst of a first radio signal on a first radio link;

determining first channel information about the first radio link using the first burst; and

subsequently, receiving a next burst of the first radio signal on the first radio link using the first channel information.

16. The method of claim 15 further comprising:

storing the first and second channel information for subsequent use.

17. The method of claim 15 further comprising:

receiving a first burst of a second radio signal on a second radio link; and

determining second channel information about the second radio link using the first burst of the second radio signal.

18. The method of claim 15 wherein receiving the first burst of the second radio signal comprises:

receiving the first burst;

determining the second channel information about the second radio link and storing the channel information about the second radio link for subsequent use;

using the stored information to demodulate the second burst of the second radio signal.

19. The method of claim 15 wherein determining the first channel information comprises:

determining phase of a carrier of the first radio signal.

20. A carrier phase recovery method for use in a multiple-link hopping, burst adaptive modem, the method comprising:

receiving a modulated carrier signal as a series of bursts, each burst including one or more pilot symbols and data symbols;

forming a coarse estimation of carrier phase using the one or more pilot symbols;

forming a fine estimation of carrier phase using the coarse estimation of carrier phase to estimate carrier phase for a burst using data symbols of the burst; and

correcting carrier phase for the radio signal using the fine estimation of carrier phase.

21. The method of claim 20 wherein estimating the carrier phase comprises averaging all data symbols of the burst.

22. The method of claim 20 wherein estimating the carrier phase comprises averaging a window of data symbols of the burst.

23. The method of claim 20 wherein forming a coarse estimation of carrier phase comprises:

sampling the one or more pilot symbols of a burst of the radio signal; and

extracting phase of the samples according to a CORDIC algorithm.

24. The method of claim 23 wherein forming a fine estimation of carrier phase comprises:

forming a complex phasor in response to the extracted phase; and

de-rotating the data symbols using the complex phasor.

25. A carrier phase recovery system comprising:

a first equalizer configured to equalize a present burst of data using equalizer weights from a previous burst of pilot symbols and data symbols, the present burst of data including pilot symbols and data symbols;

a carrier phase recovery unit which recovers phase for the present burst of data using the pilot symbols of the present burst;

a mixer combining a delayed version of the present burst and the recovered phase to produce a phase-error compensated signal; and

a second adaptive equalizer which equalizes the phase-error compensated signal to produce an equalized output signal and provides next burst equalizer weights to a memory to be timely applied to the first equalizer for equalizing a next burst of data on the same link

26. The carrier phase recovery system of claim 25 further comprising:

a memory circuit coupled to the second equalizer to store the next burst equalizer weights.

27. The carrier phase recovery system of claim 25 wherein the carrier phase recovery unit comprises:

a coarse carrier phase estimation circuit; and

a fine carrier phase estimation circuit to produce the recovered phase.

28. The carrier phase recovery system of claim 27 wherein the coarse carrier phase estimation circuit is configured to produce a coarse estimate of the phase for the present burst of data using the pilot symbols of the present burst of data.

29. The carrier phase recovery system of claim 28 wherein the fine carrier phase estimation circuit is coupled to the coarse carrier phase estimation circuit to produce the recovered phase using the coarse estimate of the phase and at least some of the data.

30. The carrier phase recovery system of claim 29 wherein the fine carrier phase estimation circuit is coupled to the equalizer to receive an initial equalized signal.

31. The carrier phase recovery system of claim 30 wherein the coarse carrier phase estimation circuit is coupled to the equalizer to receive the initial equalized signal.

32. The carrier phase recovery system of claim 27 wherein the fine carrier phase estimation circuit comprises a de-rotating circuit coupled to the equalizer to receive an initial equalized signal to remove estimated coarse carrier phase from the initial equalized signal responsive to an estimate signal from the coarse carrier phase estimation circuit.

33. The carrier phase recovery system of claim 32 wherein the de-rotating circuit is coupled to the coarse carrier phase estimation circuit to receive a phasor signal as the estimate signal.

34. The carrier phase recovery system of claim 27 wherein the fine carrier phase estimation circuit is configured to remove a modulated signal from a carrier to produce the recovered phase.

35. The carrier phase recovery system of claim 34 wherein the fine carrier phase estimation circuit comprises a data-aided decision-directed apparatus to remove the modulated signal from the carrier.

36. The carrier phase recovery system of claim 35 wherein the fine carrier phase estimation circuit comprises an averaging circuit coupled to the data-aided decision-directed apparatus to reduce noise in the carrier.

37. A phase correction apparatus comprising:

means for receiving a distorted signal;

means for compensating for the phase of the distorted signal including:

means using known pilot symbols in the distorted signal for obtaining a coarse estimate of carrier phase for the distorted signal, and

means using data of the distorted signal for removing modulated signals from the coarse estimate of carrier phase to produce a carrier estimate.

38. The phase correction apparatus of claim 37 further comprising:

averaging means for averaging a predetermined number of symbols of the carrier estimate for reducing noise variance.

39. The phase correction apparatus of claim 37 wherein the means for obtaining a coarse estimate comprises:

means using samples corresponding to the pilot symbols for estimating phase of the samples.

40. The phase correction apparatus of claim 39 wherein the means for estimating phase comprises:

means for estimating phase based on a CORDIC algorithm; and

means for forming a complex conjugate signal responsive to the estimated phase.

41. The phase correction apparatus of claim 37 wherein the means for removing modulated signals comprises:

a slicer for producing symbol samples from an equalized signal produced responsive to the distorted signal; and

de-rotator means for rotating the symbol samples into a collinear alignment to remove the modulated signals.

42. A carrier phase recovery system for use in a multiple-link hopping and burst adaptive modem in steady state operation, the carrier phase recovery system comprising:

a memory;

a fixed equalizer for pre-compensating amplitude and phase variations of a present data burst of a present link through the fixed equalizer for which the tap coefficients pertinent to a previous burst of the present link are loaded from the memory, the fixed equalizer producing a pre-compensated amplitude and phase signal;

a carrier phase recovery unit extracting distorted carrier phase for a plurality of communication links, the carrier phase unit including:

a first stage which acquires a coarse estimate of the distorted carrier phase using a pilot-aided technique using multiple known pilot symbols contained in the present burst of data;

a fixed phase bias removal stage coupled to the first stage;

a complex conjugate phasor generating stage coupled to the fixed phase bias removal stage;

a de-rotating means for de-rotating the equalized signal by a phasor signal generated by the phasor generating stage to remove estimated coarse carrier phase from the equalized signal to produce a coarse phase compensated signal;

a data-aided phase estimator stage for removing modulated signal from the coarse phase compensated signal using a data-aided, decision-directed technique;

an averaging means for averaging M symbols from the data-aided phase estimator stage to reduce noise variance; and

an adaptive equalizer stage for generating the tap coefficients and storing the tap coefficients in the memory.

43. A carrier phase recovery system for a link-hopping adaptive burst modem used in a join operation of a radio system including a plurality of communication links, the carrier phase recovery system comprising:

a pilot-aided phase compensation unit which uses K known multiple pilot symbols and an algorithm to extract estimated carrier phase in the join operation; and

smoothing means for forming a finer estimate of the estimated carrier phase through an averaging process over the K pilot symbols.